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A DIVISION OF GENERAL DYNAMICS CORPORATION



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SAN DIEGO 12, CALIFORNIA

TELEPHONE: CYPRESS 6-6611

24 October 1958  
11-0-4358

25X1

Subject: Extended "Hazel" Studies  
Inclosure: (A) Statement of Work (3 copies)

25X1 Dear

In compliance with your request, Convair herewith submits its proposal for continuation of subject study. This study is in two parts. Item 1 will be completed on January 30, 1959 with final report submitted on February 15, 1959. Item 2 will be completed on November 7, 1958, with a presentation and final report being submitted two and three weeks respectively thereafter.

Subject studies will be conducted in general accordance with the statement of work submitted herewith as Inclosure (A). The Contractor would anticipate this contract being let on a cost-plus-fixed-fee basis, at an estimated cost of \$46,627 to which should be added a fixed fee of \$3,264, making a total estimated cost and fixed fee of \$49,891. No additional capital facilities will be required for this study.

Contractor represents that it has not employed or retained any company or person (other than a full-time bona-fide employee working solely for the Contractor) to solicit or secure this contract and that it has not paid or agreed to pay any company or person (other than a full-time bona-fide employee working solely for the Contractor) any fee, commission, percentage or brokerage fee contingent upon or resulting from the award of this contract; and agrees to furnish information relating thereto as requested by the Contracting Officer.

Contractor will be pleased to submit any and all additional information that you may require. Contractor's obligation to perform pursuant to this proposal is contingent upon the negotiation of a mutually satisfactory contractual document.

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GENERAL OFFICES: SAN DIEGO, CALIFORNIA

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CONVAIR - San Diego

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Statement of Work

Inclosure (A) to  
Letter 11-0-4358

Project Hazel Continued Studies

Objectives - The objectives of these continued studies are two-fold:

- Item I - To continue studies of type systems investigated in the past, namely Mach 3 @ 125,000' min. altitude utilizing unique construction methods of inflatable vehicle structure and light weight structure ram jet engines (such as sandwich construction plastic or metal).
- Item II - To initiate new studies of systems to accomplish same basic mission, but with typical metal type vehicle construction and metal ram jet and/or turbojet engines. This system shall operate at Mach 3.0 at an average cruise altitude of approximately 90,000 ft.

Item I - Mach 3 - 125,000 ft. minimum cruise altitude system

1. Boost Analysis

Utilizing the vehicle configurations generated to date, conduct a study of various boost systems, indicating the various advantages and disadvantages applicable to each system investigated. In particular, determine the required design penalties built into the cruise vehicle per each type of boost system.

2. Radar Cross Section Model Test

Construct radar cross section models of most promising configuration and conduct test as required to determine design information necessary to arrive at optimum configurations for min. cross section.

**SECRET**

**SECRET**

CONVAIR - San Diego

Page 2

**3. IR Detection Studies**

Conduct studies of most promising configuration to determine, per calculations, the sensitivity to predicted enemy detection systems. Determine the possible test methods to be employed to check calculations. Conduct those tests if studies indicate sufficient knowledge can be gained to warrant cost.

**4. Structural Weights**

- A. Investigate in more detail than previous studies, the structural load factors necessary to cover the launch phase, gust loads, cruise and landing conditions. Determine the resultant structural weights of vehicle and supply data to engine manufacturers for their engine structural weight determinations.
- B. Using the data generated above, determine the wing weights of a typical light weight metal wing structure, and resize a vehicle using this wing weight.

With this type of structure, Convair San Diego will design a model wing for the purpose of comparison with an inflatable wing model under fabrication by the Goodyear Aircraft Company. This wing model will be approximately 13 feet maximum dimension. Convair San Diego will conduct a structural analysis and load deflection determination of this model wing in order that these data might be compared with the results of the inflatable model of Goodyear's.

**SECRET**

**SECRET**

CONVAIR - San Diego

Page 3

**5. Fuel Selection**

Investigate the overall system problems in conjunction with various fuel effects, such as vehicle performance, weight, hazard; logistics of water based and land based systems; and overall system cost and availability.

**Item II - Mach 2.5 to 3.0 - 90,000 ft. average cruise alt. system****1. General Requirements**

Range	4,000 n. mi. minimum
Cruise Altitude (Average)	Approximately 90,000 ft.
Cruise Velocity	M 2.5 if practical Max. M <sub>0</sub> 3.0
Payload	500#
Structure	Conventional rigid metal structure conventional metal engines.

**2. Configuration Studies**

Conduct studies to determine most promising configuration consistent with the above requirements. This study to be directed toward achieving the highest L/D consistent with wing structural design.

**A. Wing Structure**

Conventional metal structure will be studied as a first priority.

A small side study will compare rigid plastic honeycomb and pressure stabilized metal structure.

**B. Power Plants**

(1) Cruise engines - Both ramjets of the type considered in

previous studies will be investigated (Pratt & Whitney and

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CONVAIR - San Diego

Page 4

## 2. B. (1) (Cont'd)

Marquardt). Turbojet engines will also be investigated to determine their practicability as a cruise power plant.

(2) Fuels - Primary emphasis will be on pentaboron fuels with brief comparison studies on SF-1 and JP4.

C. Miscellaneous Systems

Weight and power requirements of miscellaneous subsystems aboard the vehicle such as auxiliary power plant, controls, guidance and navigation systems, pilot environmental control, etc., will be assumed to remain as determined in previous studies with only slight changes as necessary for new altitude requirement.

3. Launch System

Studies will be conducted to determine the most practical launching system. Studies will include, but not be limited to, launch from aircraft (such as B36 or B58) then rocket boost to cruise alt. and speed; rocket boost from ground up to cruise alt. and speed; the possibility of ramjet climb out will be investigated for the two previous systems.

No ramjet variable geometry will be considered. In the event turbojet engines configuration result as cruise vehicles, various launch and climb out techniques will be investigated including the typical take-off and climb to cruise alt.

**SECRET**

**SECRET**

**CONVAIR - San Diego**

**Page 5**

**4.     Invisiblity**

An attempt will be made to minimize the radar and IR detectability of the configurations studied. However, no design or performance penalty will be built into the vehicles for this reason.

**5.     Sea Basing**

Studies will include proposed methods of sea basing the most promising system, considering fuel logistic problems as well as launching and handling problems.

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**REPORTS AND SCHEDULES**

**Item I**

<b>Effective Start Date</b>	<b>November 1, 1958</b>
<b>Study complete</b>	<b>January 31, 1959</b>
<b>Presentation</b>	<b>January 31, 1959</b>
<b>Final report</b>	<b>February 15, 1959</b>

**Item II**

<b>Effective Start Date</b>	<b>October 13, 1958</b>
<b>Study complete</b>	<b>November 7, 1958</b>
<b>Presentation</b>	<b>November 21, 1958</b>
<b>Final report (Brochure of Presentation Charts)</b>	<b>November 28, 1958</b>

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Engineering Direct Labor - 3250 @ \$4.42	\$ 14,365
Overhead - 3250 @ \$3.69	11,992
IBM 704 - 3 hrs. @ 400/hr.	1,200
Travel - 3 man-trips 3 x 350	1,050
Per Diem - 5 day/trip \$12/day	<u>180</u>
<b>Total Estimated Cost</b>	<b>\$ 28,787</b>
<b>7% Fee</b>	<b><u>2,015</u></b>
	<b>\$ 30,802</b>

**Item II**

Engineering Direct Labor - 2,000 @ \$4.42	\$ 8,840
Overhead - 2,000 @ \$3.69	7,380
IBM 704 - 2 hrs. @ 400/hr.	800
Travel - 2 man trips 2 x 350	700
Per Diem 5 day/trip \$12/day	<u>120</u>
<b>Total Estimated Cost</b>	<b>\$ 17,840</b>
<b>7% Fee</b>	<b><u>1,249</u></b>
	<b>\$ 19,089</b>

**Total Cost**

<b>Item I</b>	<b>\$ 30,802</b>
<b>Item II</b>	<b><u>\$ 19,089</u></b>
	<b>\$ 49,891</b>

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